Bliss Triumph in particular it is a matter of considerable importance, and the result of these experiments shows that the disease can be readily controlled by field selection of the stock intended for planting next season.

It is believed that the experiments reported here are the first that have definitely shown that potato mosaic is transmitted through the tubers. A series of photographs have been taken which show the difference between the progeny of healthy and mosaic parents and it is intended to publish a fuller account of the experiments at an early date.

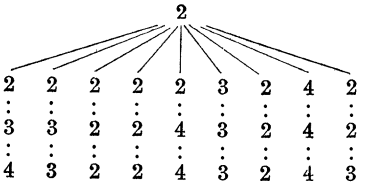
E. J. WORTLEY

PAGET EAST, BERMUDA

THE INHERITANCE OF EXTRA CONTRACTILE VACUOLES IN AN UNUSUAL RACE OF PARAMŒCIUM CAUDATUM

IN the early part of January, while examining paramœcia from a general culture maintained for laboratory purposes, it was noticed that one of the individuals had three contractile vacuoles. Further investigation showed this condition to be the rule rather than the exception, and a number of single individuals, each showing three vacuoles, were isolated with which to start pure-line cultures.

The descendants of these single individuals showed wide variation in vacuole number. In one pure line several weeks after it started 8.6 per cent. of the individuals had two vacuoles, 65.7 per cent. had three and 25.7 per cent. had four. In other cultures numbers as high as five and even six vacuoles appeared rarely. Immediately after division the average number is lower; in some very rapidly dividing cultures as many as 59.1 per cent. of the individuals may have only two vacuoles, though this return to the normal number apparently is only temporary, as the same individuals may later develop a third or even a fourth vacuole. This condition is represented by the following experiment in which an individual showing two vacuoles was allowed to pass through several divisions and then three observations were taken on each of the descendants at intervals of from four to five hours.



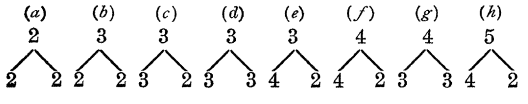
It is evident that all the individuals starting with two vacuoles did not later acquire a third, nor did all those having three to begin with have four before division. Those paramœcia possessing but two vacuoles, although they may divide without having shown an increase in the number of vacuoles, have not lost the power of producing extra contractile organs though several generations may be passed through before they appear.

In this multi-contractile vacuoled race the extra vacuoles are with very few exceptions located in the posterior half of the *Paramœcium*. In cases where three are present, two are found in the posterior half and one in the anterior. Only two cases have been observed in which the reverse condition was true. When four vacuoles exist the arrangement is generally three in the posterior and one in the anterior end, although there may be two in each end.

No exact observations have been made as yet on the formation of the new vacuoles. Very small vacuoles have been seen which have apparently just formed and which are usually at some distance from the others. These increase fairly rapidly in size until they reach the maximum. During the growth of some new vacuole, the one nearest to it loses temporarily its regular contraction. When the new vacuole has reached full size it beats spasmodically a few times before it settles down to its regular rhythm. Shortly the old and the new vacuoles become accustomed to the new conditions and the usual rhythmic beat begins. This is not always the case, as vacuoles have been observed to form without affecting the rhythmic beat of the older vacuoles near it in the slightest.

It is practically impossible at present to predict with certainty what number of contractile

vacuoles the offspring of any individual may have immediately following division. Some of the possibilities observed up to date are illustrated below.



Apparently at division two vacuoles are added in the normal way as a rule (one to the posterior end and one to the anterior). This is not invariable as is evidenced by (*b*), (*d*) and (*h*). As stated above, although a *Paramœcium* of this race may not show an increase of vacuole number up to the time of division it has not lost the power to produce extra vacuoles. In cultures started with two-vacuoled forms, individuals have been found showing three and four vacuoles. The most common distribution at division in the three-vacuoled individuals is three vacuoles to the posterior part and two to the anterior half. There is no fixed order in the distribution of the vacuoles at division and no definite time at which the extra contractile vacuoles appear in the life cycle of the individual. The only definite statement that may be made of this race is that it has a tendency to more than two contractile vacuoles.

The race is strong and healthy and some of the individuals are very large. There is no invariable relation between the size of the animal and the number of vacuoles. A small animal may have more than a larger one. Since the race has been under observation (about four months) there have been two periods of extremely rapid division, the rate rising to five divisions in twenty-four hours and continuing at this rate for six or seven days. During these periods no individuals with four or five vacuoles were seen and the two-vacuoled forms seldom passed into the three-vacuoled condition before division, although they did not lose the power of returning to the higher numbered vacuoled state when the division rate slowed down.

The original laboratory culture was started by Dr. Merkle Jacobs in the fall of 1914. The paramœcia he had been using in high temperature experiments were thrown into a battery jar of hay infusion. So far as is known, the animals used for these experiments had the normal number of contractile vacuoles, though there is a possibility that the higher number were already present. The irregularity of the behavior of the extra contractile vacuoles would seem to indicate that they were recently acquired structures that had not become as yet firmly established as a part of the organism. There has also been some slight indication lately, observed by both Dr. Jacobs and myself, of a tendency to settle down into a more regular order with three as the maximum number of vacuoles.

Since *Paramœcium caudatum* has been the most widely studied protozoan and no cases have been reported where extra contractile vacuoles have been found, considering the origin of the culture, there is some excuse for suggesting that this potentiality for extra vacuoles may have been acquired. The great irregularity of the time of formation of these vacuoles along with the tendency to become more regular, as stated above, would seem to bear this hypothesis out. The paramœcia of the original culture had been subjected to a temperature of at least 40° Centigrade and it might be supposed that the extra vacuoles were formed under the stress of the unusual environment. Furthermore, Dr. Jacobs has found that this race is abnormally resistant to high temperatures. Under the conditions where ordinary race of paramœcia are killed at temperatures of 40° Centigrade to 42° the race in question will survive an exposure to 44° or more.

A more extended account will be published shortly giving more of the details and methods. It is intended later to attempt to develop a new multi-vacuoled race by subjecting normal individuals to high temperatures in order to test the hypothesis suggested above.

Dr. Jacobs has carried on experiments with the same race of *Paramœcium* which have confirmed those recorded here.

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